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Book reviews

John Quiggin, *Generalized Expected Utility Theory: The Rank Dependent Model.* Kluwer Academic Publishers, 1993. Pp. 207, xii. ISBN 0-7923-9302-3.

Expected Utility theory (EU) has long been the dominant theory in the field of decision making under risk and uncertainty. Yet there has also been a continuous flow of experimental evidence incompatible with EU, resulting in well-known paradoxes and effects, such as the Allais paradox, the Ellsberg paradox, the common ratio effect, framing effects, and preference reversals. Although EU theory may still carry the day as a normative theory, there is a growing need for new theories relaxing EU to satisfy the detected phenomena. One of the most popular branches in the non-EU theories is rank-dependent expected utility theory (RDEU). Although it has gained great popularity among economists, it is an inspiring model for psychologists too.

In EU, risk attitudes can be modelled by the shape of the utility function only. Aversion of risk is explained by a concave utility function (i.e., monotonically increasing but with decreasing acceleration) reflecting a diminishing marginal utility of wealth. Although this idea is in accord with general intuition, it does not seem natural that people's attitudes towards outcomes form the sole factor determining behavior in risky settings. The interesting aspect of RDEU theories for psychologists is that attitudes towards probabilities are incorporated in the model.

The idea of generalizing EU by incorporating probability transformations is not new. Back in the fifties, Edwards studied a theory that introduced a straightforward probability-transformation function. In 1979, Kahneman and Tversky incorporated probability transformations in Prospect Theory, a theory that immediately became popular. A formal theory explaining behavior under risk, however, not only has to provide good descriptions of actual behavior but also has to prove its value in theoretical research. The crucial *dis*advantage of these earlier theories has been the lack of a sound theoretical underpinning. A straightforward transformation of probabilities leads to violations of stochastic dominance, the property stating that if an option A yields more than an option B with certainty, then A is preferred to B. (Prospect theory evades this violation by the introduction of an editing operation and by restricting the range of considered prospects to prospects with at most two non-zero outcomes.) It will be of no surprise that there is no plausible axiomatization of these theories. The most important new feature of the

RDEU model is that probabilities are transformed in a theoretically sound manner. Informally, one can state that in RDEU cumulative probabilities are transformed. By a cumulative probability we mean a probability of getting an outcome x or any outcome valued less than x. In this way, the rank order of the outcomes becomes crucial to the way the probabilities are transformed. The use of cumulative probabilities is also psychologically plausible. People often consider the probability of a compound event that is rank dependent, for example, the "chance to break even" (e.g., Lopes, 1990).

Quiggin's book is an introduction to and theoretical survey of the rank-dependent model. It starts with an introduction to EU and an overview of derived results, which are mostly applied in economics. After a brief survey of the major descriptive problems of EU (mentioned above) and some proposed solutions, Quiggin gives an extensive treatment of RDEU. An important project of the book then is to reformulate theoretical results of EU to make them compatible with RDEU, such as measures for risk, risk-aversion and dominance. The book concludes with smaller expositions, including an RDEU explanation of gambling behavior, a discussion of normative components of RDEU, experimental results, axiomatizations, and a brief review of competing generalized expected utility models.

The most salient aspect of Quiggin's book is that it has primarily been written for economists. This has some implications. Most importantly, it implies that most subjects and arguments are highly theoretical. As a consequence, many of the subjects the book is dealing with are not at the core of interest for psychologists. Quiggin also takes his readers as mathematically well skilled (although it must be said that, relatively, the mathematics is easy). Also, at some places he assumes some economic background knowledge (Gini-coefficients, Jensen's inequality, "Arrow-Debreu style view of the world"). A major advantage, however, is that the book is well structured, which makes it easy to skip paragraphs or chapters that are too economic for one's personal taste.

The experimental part of the book is disappointing. First, as most economists, Quiggin has reservations about laboratory results, mostly because of the lack of proper incentives. So, Quiggin criticizes standard experimental procedures, highlighting a quite unintelligible critique of the isolation effect that is often used in justifying psychological research. Second, Quiggin does not pay much attention to the available experimental results. This is a bit surprising as he underwrites the view that experimental findings made generalisations of EU worthwhile. One thus would also expect a report whether available experiments show that RDEU provides a good explanation of the reported paradoxes and effects. This is not the case. Quiggin's experimental discussion of the Allais paradox serves well the purpose of an example. He shows that RDEU can solve the paradox by giving a simple example of some values of functions of the model, values that are not generated by experiments or somehow related to experimental findings. Experimental results that are presented provide only a fuzzy comparison between RDEU and other theories (some of which are not even discussed).

An important and interesting point suggests itself: what normative status should

one attach to the RDEU model? Is RDEU a descriptive theory that agrees with normative canons as much as possible, or is it also defensible as a normative theory? One need not have an opinion on this issue (the difference is also not as sharp as one would wish) but it is certainly a point of interest. In his discussion of normative features of the model, Quiggin presents some arguments (connected with the dynamic consistency debate) pro and contra the normative appeal of EU but does not take a stand. In his discussion of the Allais paradox, however, Quiggin seems to hold the second point of view: the independence axiom (or the sure thing principle), characterizing EU, is normatively questionable. RDEU theory relaxes precisely this axiom, so RDEU could well be normatively appealing. The argument against the independence axiom is negative and, in our opinion, not very convincing in the way Quiggin presents it. He states that if two gambles share an identical outcome-probability event but the events of the two gambles are rank ordered differently, then there is no reason why the identical outcome-probability event must be equal to subjects.

In our opinion, it is not the exchangeability of events *per se* that should be questioned (although it boils down to a violation of this principle). The argument can be stated in an intuitively more appealing manner. Suppose I am pessimistic by nature. In this case I will pay more attention to the lower outcomes. It can be argued that this is also the rational thing to do for me. Should I not avoid bad outcomes to avoid disappointment? This implies that the rank order of the outcomes is a rationally relevant factor. We could strengthen this point by questioning the basic principle of rational decision making: the maximization of expected utility. Why should one not rather maximize expected utility, in some way bounded by the avoidance of disliked outcomes? If we accept that these factors are not only descriptively valid, but also have rational impact, RDEU also becomes interesting as a normative challenge to EU. We are not sure if this line of reasoning will stand serious scrutiny. However, if experiments show that people have preferences that are well described by RDEU (but violate EU) and, furthermore, stick to their preferences even after due deliberation, then the normative appeal of RDEU is improved.

We have concentrated on the parts of the book that are of most interest to psychologists, and we are not enthusiastic on this respect. On the other hand, we think Quiggin's book provides a good introduction and summary of the major theoretical results concerning RDEU theory. From a theoretical point of view Quiggin's coverage of subjects is impressive. Quiggin also gives some highly recommendable arguments concerning gambling behavior and a nice proof of the naturalness of the RDEU form (§ 5.8). It is a pity the book contains quite a few typographic errors and some minor inaccuracies.

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Oleg I. Larichev, Helen M. Moshkovich, Eugene M. Furems, Alexander I. Mechitov and Vladimir K. Morgoev, *Knowledge Acquisition for the Construction of Full and Contradiction Free Knowledge Bases*. ProGamma, Groningen, 1991. ISBN 90-5144-021-9.

This book reflects the work of a group of Russian scientists in the area of expertise in classification tasks. This topic is approached from two different angles: a psychological one, mainly based on work in cognitive science and behavioral decision theory, and a knowledge-based systems engineering one, resulting in computer programs that carry out expert classification tasks.

The first approach can mainly be found in Chapters 4 to 7. In general, the reported results are, from a purely psychological point of view, not very new. They mainly confirm what is already known: distinct limitations to human capabilities in complex multi-attribute classification problems. Experts outperform non-experts by being able to simplify the task by discarding attributes. Another trick is to place the attributes in a hierarchy which enables the classifier to deal with complexity by "generalizing" certain attributes.

The interesting side of the reported research is the linking of these limitations to computer programs that help the classifier in avoiding contradictions and inconsistencies in judgments that occur as a consequence of these limitations. Two algorithms for this are described in Chapters 5 and 6. They can be seen as an innovative way of dealing with inconsistencies in knowledge acquisition. Though Chapters 4 to 7 contain some references to the literature, important work in this area (for example the work on the cover-and-differentiate algorithms) is overlooked. More in general, some chapters are poor in references to research going on outside the group. Also, most of the references do not extend beyond 1987, which severely limits the usability of the book as a source for recent work in this area.

The knowledge engineering part is mostly visible in Chapters 3 and 9 to 11. Chapter 3 gives a reasonable overview of work in the field of knowledge acquisition and elicitation, though it misses, as mentioned before, some recent developments, like workbenches for supporting knowledge elicitation. Chapters 9 to 11 each describe a specific computer program used for knowledge acquisition in expert classification tasks. The ARIADNA system (Ch. 9) is an innovative way of computer-based interviewing, a dialogue between the system and the expert. In